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28 June 2011

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SUMMARY

Using cross-country data, this paper investigates how governance influenced views regarding the security of nuclear energy after the 2011 disasters in Japan. Key findings are: (1) citizens are less likely to agree that nuclear power plants are properly secured against accidents with the presence of a free media and higher levels of freedom of expression; and (2) freedom of expression and free media are positively associated with the presence of nuclear plants. These findings indicate that sufficient information leads citizens to both understand the risk of nuclear energy and to accept the existence of nuclear plants.

Keywords: Natural disaster, Nuclear energy, Governance, Information asymmetry.

JEL classification: D73, D82, H12, Q54.

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I.INTRODUCTION

Japan was struck by one of the largest earthquakes in recorded history on March 11, 2011. Following the earthquake, a devastating tsunami arrived at the northeastern coast of Japan. The combination of earthquake and tsunami resulted in catastrophic damage. Hammer (2011, p. 28) states 'As many as 18,000 people were killed. Hundreds of thousands remain homeless. Estimates vary, but the World Bank and Japanese government say that there's somewhere between $122 billion and $235 billion worth of damage to clean up.' The Fukushima Daiichi nuclear plants, located on the Fukushima coast (northeastern Japan), were crippled by the disasters, causing Japanese citizens to confront the danger of nuclear leakage.

Nuclear leakage appears to be caused not only by natural disasters but also human error as explained below. The electricity market in Japan is considerably concentrated; a few incumbent companies enjoy a large share of the market. Hence, electricity companies such as the Tokyo Electric Power Co have significant market power and so gain larger profits than in a competitive market. Such market power is evident in the fact that Tokyo Electric Power Co, which operates the Fukushima nuclear plants, ignored warnings that the reactors were vulnerable. In a competitive market, competition would induce electricity companies to consider such warnings and improve the security of the nuclear plants. Furthermore, Tabuchi et al. (2011) reported 'Just a month before a powerful earthquake and tsunami crippled the plant … government regulators provide a 10-year extension for the oldest of the six reactors at the power station despite warnings about its safety.' Japan's chief cabinet secretary, Yukio Edano, defended the government regulators and the Tokyo Electric Power by saying that 'at

least, they were fully prepared for emergency situations based on the natural disaster information for the last 100 years or so.' The nuclear disaster rating for Japan's nuclear accident has since been upgraded from level 5 to level 7, a level reached only once before in the Chernobyl disaster (Tabuchi and Bradsher, 2011). The level of damage and loss caused by the nuclear accident appear to have increased as a result of confusing information provided by government. Bonanno (2011) states that the 'problem is the growing mistrust of the government. The administration in Tokyo has consistently failed its people by providing confusing and often inaccurate information about the extent of the damage. They have also been frustratingly vague about the possible dangers of radiation contamination.' The nuclear disaster in Japan has been characterized by Zeckhauser (1996, p. 115) as follows: 'If the probabilities of catastrophe are not appropriately assessed and if those values are not disseminated and acted upon, we must expect poor outcomes.'

The infamous Three Mile Island accident occurred in the United States on March 28, 1979, and is recognized as one of the most terrible nuclear disasters in history. The worst nuclear accident is considered to be the Chernobyl incident, which occurred on April 26, 1986 in the Ukraine. Since these two serious nuclear accidents, the security of nuclear energy has been at the fore of public attention. More recently, data regarding the long-term effect of the Chernobyl disaster has been accumulated, enabling the economic and political outcomes of the Chernobyl accident to be analyzed in the field of social science. Danzer and Weisshaar (2009) found that Ukrainian citizens whose family members were affected by the Chernobyl's disaster are more likely to be unhappy. However, Chernobyl's influence was not limited solely to the Ukraine; it also had a significant influence in other European countries. Almond et al. (2009) used data from

Sweden to present evidence that students born in regions exposed to higher levels of Chernobyl radiation fallout performed worse at secondary school. In Germany, people became more likely to worry about the environment after the Chernobyl disaster, even though the disaster did not reduce the life satisfaction of German citizens (Berger, 2010). Major disasters also influenced the outcomes of election and policy in the United States (Eisensee and Strömberg, 2007; Kahn, 2007).

Japan's nuclear disaster, which followed the earthquake and tsunami, is believed to affect citizens' perceptions and views regarding the security of nuclear energy, not only in Japan but worldwide. For instance, Dempsey (2011) states 'after the catastrophe in Japan, Mrs. Merkel reversed a pro-nuclear policy that she adopted just last year and temporary shut down seven of Germany's 17 nuclear plants.' Despite the change of pro-nuclear policy, Merkel's conservative Christian Democrats suffered a major defeat in the election 2 weeks after the Japanese disaster. Switzerland has since announced a halt on the construction of new nuclear plants and the United States congress has called for hearings on nuclear safety.

Zeckhauser (1996, p. 115) states, 'if people merely worry about floods and can do nothing to prevent them or to reduce their costs, then it is best to alleviate their worries. However, underperception leads to inappropriate actions when preventive measures could be taken.' Governance has a critical influence on media and in turn the information obtained by citizens. Free media has been allowed to flourish, contributing to greater political accountability and improving citizens' perceptions. Under such conditions, politicians who are aware that voters are well-informed regarding politicians' activities have a greater incentive to offer benefits to all citizens rather than just to small pressure groups (Besley and Burgess, 2002). The role of governance is

considered to be important and therefore requires investigation in situations when unexpected events, such as a natural or nuclear disaster, occur (Kahn, 2005; Escaleras et al., 2007). Quality of governance is believed to affect views regarding nuclear energy, and, therefore, citizens' voting behavior, especially when nuclear disaster occurs. Hinman et al. (1993) used data from the 1990s to compare the perceptions of nuclear risks between Japan and United States. However, little is known regarding the effect of the quality of governance on perceptions and views concerning the security of nuclear energy. Catastrophe caused by natural and nuclear disasters often provokes controversy regarding nuclear energy, a topic that is currently very prominent worldwide. Thus, it is would be worthwhile and timely to investigate the association between institutional factors and citizens' views regarding nuclear energy. To this end, using cross-country data collected after the 2011 Japan disaster, this paper attempts to examine how the governance of media influences views regarding the security of nuclear plants when natural disasters occur. The key finding is that citizens are more likely to understand the dangers of nuclear plants in countries where freedom of expression and a free media are assured to a greater degree.

The structure of this paper is as follows. Section II surveys the related literature. Data and empirical strategy are explained in section III. The results of the estimations are reported in section IV. The final section presents my conclusions.

II. RELATED LITERATURE

Over the years, there has been an increase in the level of academic attention paid to natural disasters. Recently, an increasing number of researchers have attempted to investigate the outcomes of natural disasters; for instance, the influence of disasters on

economic loss and deaths (e.g., Kahn, 2005, Escaleras et al., 2007; Toya and Skidmore, 2007; Yamamura, 2010), economic growth (e.g., Skidmore and Toya, 2002; Crespo-Cuaresma et al., 2008), and fiscal decentralization (Toya and Skidmore 2010).

Both low income inequality and high-income leads to lower levels of damage caused by disasters (e.g., Anbarci et al., 2005; Kahn, 2005).[1] However, Japan suffered significant damage in the 2011 disaster, despite high-income levels and relatively low economic inequality. As well as economic condition, disaster prevention measures are important to reduce the level of damage sustained in a disaster. Escaleras and Register (2007) suggest that early warning tsunami systems contribute to reduce tsunami deaths. This system is employed in tsunami prone areas such as Japan. However, a large number of citizens were killed by the tsunami in the 2011 disaster in Japan. Thus, other factors also appear to be determinants of disaster damage.

Higher levels of education, a more comprehensive financial system, and a smaller economic government result in a smaller disaster death rate (Toya and Skidmore, 2007). Yamamura (2010) used Japanese panel data to find that social capital enhances the learning effect of a disaster experience, thus, reducing the level of damage from a disaster. From a public choice viewpoint, researchers have pointed out a number of problems stemming from massive government failures to cope with the risk of disaster (e.g., Congleton, 2006; Shughart II, 2006; Sobel and Leeson, 2006). For instance, there is no incentive for the public sector to request disaster relief resources greater than those that meet base requirements, even though accurate information regarding demand and supply is provided. As a consequence, efficient resource allocation cannot

[1] Kellenberg and Mobarak (2008) asserted that the association between income level and damage levels from a disaster is non-linear. Disaster risk increases with income up to a certain level and decreases thereafter.

be realized. Political and institutional factors are, however, considered to play an important role when unexpected events occur. Kahn (2005) proposed the hypothesis that institutional quality insulates against death when natural disasters occur and found that the death rate is lower in disasters where democracy and good governance are practiced. Escaleras et al. (2007) used panel data from 1975 to 2003 establish that a less corrupt public sector leads to lower death rates from natural disasters. As well as formal institutions, unwritten social norms also play a key role in saving the lives of females and children before males and adults, as in the Titanic disaster (Frey et al., 2009).

In addition, the effect of natural disasters is examined from a psychological viewpoint in the field of social science. Researchers investigated how natural disasters affected life satisfaction (Luechinger and Raschkly, 2009; Carroll et al., 2009). Luechinger and Raschkly (2009) attempted to use the degree of life satisfaction to measure damage caused by floods in European countries from 1973 to 1998. Statistical analysis showed that floods had a detrimental effect on life satisfaction. Similarly, as with European countries, Carroll et al. (2009) found, using fixed-effect models with data from 2001 to 2004, that droughts also have a detrimental impact on life satisfaction in rural areas in Australia. Daly and Wilson (2009), using data from the United States, argued that the determinants of well-being were the same as the determinants for suicide. Furthermore, Chuang and Huang (2007) found that the number of suicides increased as an outcome of natural disasters, which is consistent with the finding of the works above (Chuang and Huang, 2007).

Chernobyl is considered to be the most devastating nuclear disaster to have long-term detrimental effects on health status, and, in turn, on the performance of the

labor market in the Ukraine (Lehmann and Wadsworth, 2008). With regard to the degree of happiness, data regarding Ukrainian citizens whose family members suffered in the Chernobyl disaster has shown that they are more inclined to feel unhappy (Danzer and Weisshaar, 2009). The impact of Chernobyl has not been limited to the Ukraine. In Germany, the Chernobyl disaster changed views regarding environmental issue, although the disaster did not affect life satisfaction (Berger, 2010). In Sweden, human capital accumulation varied according to the degree of Chernobyl fallout experienced in various regions (Almond et al., 2009).

Kanno et al. (2006) developed a computational model to simulate residents' responses to nuclear disaster. They argued that it is important in a nuclear disaster to consider the decision-making process 'because ordinary people cannot perceive the dangers and progress of an accident directly from the environment, and their decisions and responses can be greatly influenced by the secondary information provided by mass media, governmental agencies, or other people.' Furthermore, the mass media and its information have an impact on government policy concerning disasters. Empirical work analyzing the influence of mass media on United States' government relief to disasters has found that relief decisions are driven by the news coverage of such disasters (Eisensee and Strömberg, 2007).

Low probability events such as natural and nuclear disasters are unlikely to draw much attention from citizens. However, once the events occur, citizens turn much of their attention to the issues surrounding such occurrences (Kurtz, 2004). Experience of disasters changes citizens' perceptions, resulting in security measures becoming a key issue for citizens (Viscusi and Zeckhauser, 2006). Japan's nuclear disaster has had a definite influence on the election in Germany, resulting in a victory for the Green Party,

which opposes pro-nuclear policy. Unexpected events, such as Chernobyl and the Three Mile Island accident, appear to affect voting behavior. Kahn (2007) examined the impact of five major disasters[2] on voting behavior and provided evidence that after a disaster liberal representatives were likely to receive more votes in favor of risk regulation. A comparative work by Hinman et al. (1993) showed a similarity between Japanese and Americans, in that both Japanese and Americans fear nuclear risks and generally feel they have little personal control over avoiding death caused by nuclear accident. However, there are also differences between the two nations: Americans are likely to believe that they have little knowledge of nuclear risk while Japanese tend to believe that they are very knowledgeable on the subject. In contrast to this finding, the 2011 Japanese disaster revealed that Japanese were not sufficiently informed regarding the predicted damage from nuclear accidents.

III. DATA AND EMPIRICAL STRATEGY

WIN-Gallup International (2011) conducted a survey regarding nuclear energy approximately 2 weeks after Japan's natural disaster. Thirty-seven countries were asked 'To what extent do you agree or disagree that nuclear power plants in your country (or near countries) are properly secured against accidents?' There were five response options: 'strongly agree', 'agree', 'neither agree nor disagree', 'disagree', and 'strongly disagree'. Response rates from each county are available from WIN-Gallup International (2011). Table A1 in the Appendix show surveyed countries. The World Bank conducted a World Governance Indicators (WGI) project and provided the

[2] The five disasters were Three Mile Island, Love Canal, Bhopal, Chernobyl, and the Exxon Valdez oil spill.

governance indicator of 'Voice and Accountability'.[3] Kaufmann et al. (2010 p. 4) state that 'Voice and Accountability' captures the 'perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.' The value of 'Voice and Accountability' becomes larger as the country's citizens are more able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

Table 1 shows the definitions of the variables used in this paper, and their mean differences between countries with nuclear plants and those without. SECR1 and SECR2 for countries with nuclear plants are significantly larger than those without nuclear plants. I interpret this result as suggesting that the citizens who live in countries with nuclear plants are more likely to believe nuclear energy to be secure and hence support pro-nuclear policy. GOVEN for countries with nuclear plants is larger than those without it and its difference is statistically significant. This leads me to argue that citizens who obtain appropriate levels of information regarding nuclear energy via the media are more inclined to support nuclear energy.

The relationship between the governance of media and views regarding security (SECR1) is illustrated in Figure 1. Figure 1 shows that the governance of media is negatively related to views regarding security. China is, however, considered an outlier because 80% citizens in China agree that nuclear energy is properly secured, which is a significantly greater percentage than in other countries. Hence, for a robustness check of Figure 1, I also present Figure 2, which demonstrates the relationship after the exclusion of the outlier (China). The negative relationship continues to be observed in

[3] Data is available from http://info.worldbank.org/governance/wgi/index.asp (accessed April 28, 2011).

Figure 2. Therefore, the negative relationship is not a result of the inclusion of the outlier. However, Figures 1 and 2 do not indicate causality and as such I will examine causality using regression estimations later in the paper. The estimated function of the regression analysis takes the following form:

$$SECR1(SECR2)_i = \alpha_0 + \alpha_1 NUCLE_i + \alpha_2 GOVEN_i + \alpha_3 NDIS_i + \alpha_4 GDP_i + \alpha_5 GOVSIZ_i + \alpha_6 EASIA_i + u_{it},$$

where SECR1 represents the rate of those strongly agreeing that nuclear plants are secured in country i. In the alternative specification, SECR2 is used as the dependent variable. α represents regression parameters and u is an error term. NUCLE is the dummy variable for the presence of nuclear plants. As explained earlier, GOVEN is the key variable to capture the degree of governance regarding media. Citizens can form an appropriate view regarding the security of nuclear power if freedom of media enables citizens to obtain sufficient information. If the government tends to conceal negative information regarding the security of nuclear energy, freedom of media leads citizens to believe that nuclear energy is not properly secured. Hence, GOVEN is anticipated to take the negative sign. NDIS is incorporated to control for the experience of natural disasters because experience influences perceptions regarding accidents caused by natural disasters (Viscusi and Zeckhauser, 2006). Economic factors are controlled by the inclusion of GDP and GOVSIZ. The location of countries appears to be related with the change in perceptions caused by the Japan disaster. Neighboring countries to Japan, such as Korea and China, are more likely to be affected by the Japanese accident. For the purpose of capturing this effect, EASIA is included.

As mentioned earlier, the Japanese government provided confusing and inappropriate information regarding the 2011 nuclear disaster. As a result, citizens now

distrust the Japanese government and have criticized government policy concerning nuclear energy. Information asymmetry between government (or media) and citizens is thought to influence citizens' views regarding the security of nuclear energy, especially when unexpected nuclear incidents occur. 'Voice and Accountability' is used as a proxy in this study for the degree of information symmetry between government and citizens in each country.[4]

As seen in the mean differences of SECR1 and SECR2 in Table 1, nuclear energy is likely to exist when people consider nuclear energy to be secured. OLS estimation results are believed to suffer from endogeneity bias because reverse causality appears to exist between the dependent variable SECR1 (or SECR2) and the independent variable NUCLE. With the aim of controlling for this bias, I used instrumental variables to conduct 2SLS estimations. Sufficient land area is required to build nuclear energy plants. In addition, it is more difficult to find the space to build plants in more densely populated countries. Hence, population density, land area, and a log of population are used as instrumental variables for the 2SLS estimations. These variables were obtained from the World Development Indicators.[5]

IV. RESULTS

The OLS estimation results are reported in Tables 2(a) and (b). The second stage 2SLS results appear in Tables 3(a) and (b). Table 4 presents the first stage results of the 2SLS estimations. In each table, results using the full sample are reported in columns

[4] Kahn (2005) used 'Voice and accountability' to examine how the quality of governance influences death rates in disasters.
[5] The data are available from HP of The World Bank http://databank.worldbank.org/ddp/home.do (accessed March 28, 2011).

(1)–(3), while results using the sample excluding the outlier (China) are in columns (4)–(6). There are a total of 37 observations, reduced to 36 when the outlier (China) is excluded. As the sample size is small the jackknife method was used to calculate the standard error to ensure that the results were not spurious.

To follow is a discussion of the OLS estimations. Table 2(a) shows that NUCLE takes the positive sign and is statistically significant in all columns. After excluding the outlier, the absolute values of NUCLE are approximately 8.50, suggesting that SECR1 for countries with nuclear plants is 8.50% larger than those without nuclear plants. GOVEN yields the negative sign and is statistically significant in all columns. Hence, freedom of media reduces the rate of citizens' believing that nuclear energy is secure. The absolute values of GOVEN are 0.30 and 0.36 when the full sample is used, and 0.20 and 0.21 when China is excluded from the sample. This means that an outlier such as China increases the effect of GOVEN on SECR1. The significant negative effect of GOVEN, however, continues to exist after removing the outlier effect. EASIA is not statistically significant in column (1), but produces a significant negative sign in column (4). This suggests citizens living in a neighboring country to Japan are less likely to agree that nuclear energy is secure when China is excluded. Other control variables were not statistically significant and they do not influence SECR1. I now turn to the results of Table2 (b), which shows a further index regarding the views of citizens (SECR2). With regard to NUCLE, and similar to the results of Table 2(a), a significant positive sign was observed in all estimations. Furthermore, NUCLE in Table 2(b) is more statistically significant than that in Table 2(a). With respect to GOVEN, a significant negative sign continues to be observed, which is similar to Table 2(a). Furthermore, absolute t-statistics range from 2.44 to 2.96, which is larger than those

shown in Table 2(a), where the range is 1.83 to 2.43. Other control variables do not become statistically significant, which is the same as exhibited in Table 2(a). On the whole, the results do not change when SECR2 is used as a dependent variable.

Looking at the results of the 2SLS estimation shown in Tables 3(a) and (b), an over-identification test provided a method of testing for exogeneity in the instrumental variables. Test statistics are not significant in columns (1)–(6) and thus do not reject the null hypothesis that the instrumental variables are uncorrelated with the error term. This suggests that the instrumental variables are valid. I see from Table 3(a) that, with the exception of column (1), the sign of NUCLE is statistically significant. Absolute values of NUCLE range from 10.0 to 11.4, which are larger than those in Table 2(a). GOVEN yields the negative sign and is statistically significant at the 5% level in all columns. Absolute values range from 0.24 to 0.36, which is almost the same as those in Table 2(a). Concerning the other control variables, and in line with Table 2(a), the results are not statistically significant. With respect to results using the alternative dependent variable (SECR2), Table 3(b) reveals that NUCLE and GOVEN yield positive and negative signs, respectively, in all columns. Furthermore, NUCLE and GOVEN are statistically significant at the 1% level in all estimations. Therefore, on the whole, the combined results from Tables 2(a), (b) and Tables 3(a) and (b) lead me to argue that the estimation results are robust when alternative specifications are used.[6]

As is exhibited in Table 4, results of the first stage estimation show that 'land

[6] The World Bank constructed various measures of quality of governance such as 'regulatory quality', 'rule of law', and 'control of corruption'. In addition to 'Voice and control', Kahn (2005) used the other variables shown above as proxies for quality of governance, and found that these variables are negatively associated with deaths as a result of disasters. Following Kahn (2005), this paper also examined the effects of other proxy variables as above, regarding views on nuclear energy although the results were not reported. No significant effects were found. The results are available upon request from the author.

area' and 'population density' take the positive and negative signs, in all columns, respectively, which is consistent with the proposition, although 'population density' is not statistically significant. Demand for electricity is increasing function of population size. The significant positive sign of Ln (population) is believed to reflect that a greater demand for electricity is a greater demand for nuclear energy. As with the results of the instrumental variables, it is also interesting to observe that GOVEN yields the positive sign and is statistically significant. Hence, freedom of media leads citizens to support the presence of nuclear energy.

Hinman et al. (1993) states 'reasons proposed for the strong feelings against nuclear technologies have ranged from irrationality and ignorance to thoughtful responses by concerned citizens to images of the horror … .' Only after they have had access to the relevant information should citizens begin their decision-making process regarding nuclear policy. Furthermore, the cost of obtaining such information should be sufficiently low, enabling democracy to function well. That is, it is important to discourage citizens from becoming 'rationally ignorant' when concerning nuclear policy, because nuclear accidents have a tremendous effect on social and economic situations as shown in the catastrophic nuclear disasters of Chernobyl, Three Mile Island, and Fukushima. I interpret the evidence presented above to mean that better governance of media decreases the consensus rates in a country (or nearby country) regarding the security of nuclear power plants against accidents. In contrast, better governance of media also increases the number of nuclear plants. This implies that pro-nuclear energy policy is supported when the benefit of nuclear energy outweighs its cost, even if citizens are unlikely to consider nuclear energy as fully secured against accidents. From this I derive the argument that the governance of media decreases information

asymmetry between government and citizens, and plays a critical role in enabling citizens to calculate the costs and benefits of nuclear energy.

V. CONCLUSION

Nuclear disaster, like the one that followed the 2011 earthquake and tsunami in Japan, results in tremendous economic loss as well as psychological damage. The degree of loss and damage caused by such disasters can be more severe because of market and government failures. A lack of competition in Japan's electricity market reduced the incentive of electricity firms to monitor the security of their nuclear energy, and this resulted in higher levels of damage from the nuclear incident. Consequently, the nuclear disaster rating for Japan's nuclear incidents reached level 7, equivalent to the rating given to the 1986 Chernobyl explosion. To make matters worse, the Japanese government provided confusing information concerning the damage caused by the nuclear incidents, causing much embarrassment to Japanese citizens, especially those who lived close to the crippled Fukushima Daiichi nuclear power plants. The Japanese government attempted to regulate information regarding the accidents. Thus, Japanese citizens were not able to obtain useful and accurate information. Zeckhauser (1996, p. 113) states 'Catastrophes are produced through a combination of actions by nature and humans. Due to inappropriate incentives, human actions often exacerbate outcomes.'

How a country is to cope in a state of emergency, such as a nuclear disaster, is a very important issue. Japan's example suggests the importance of governance regarding disaster information when a state of emergency arises. Furthermore, it is worth exploring how governance regarding information influences views and perceptions

concerning the security of nuclear energy against accidents. This study used cross-country data from 37 countries to examine how governance regarding 'Voice and Accountability' affected views on the security of nuclear energy after the 2011 disasters in Japan. After controlling for various factors and endogeneity bias, estimation results showed: (1) citizens are less likely to agree that nuclear power plants are properly secured against accidents when freedom of expression and a free media are assured to a greater degree; and (2) freedom of expression and free media are positively associated with the presence of nuclear plants.

Greater freedom of expression and free media are believed to reduce information asymmetry between government and citizens. Hence, the findings of this study imply that information asymmetry has a critical influence on the presence of nuclear plants as well as perceptions regarding the security of nuclear energy against accidents. That is, the appropriate information enables citizens to understand more fully the risk of nuclear energy, whereas citizens accept the presence of nuclear plants when insufficient information has been provided. From this I derive the argument that governance regarding 'Voice and Accountability' enables citizens to calculate the benefits and costs of the presence of nuclear energy, and then properly make a decision regarding nuclear policy.

The evidence presented in this paper is based on aggregate level data. Various individual-level characteristics are believed to influence the estimation results, with the estimation results appearing to suffer omitted variable bias. For a closer examination of the effect of serious nuclear incidents on views regarding nuclear energy, individual-level data are required. This outstanding issue needs to be addressed in future work.

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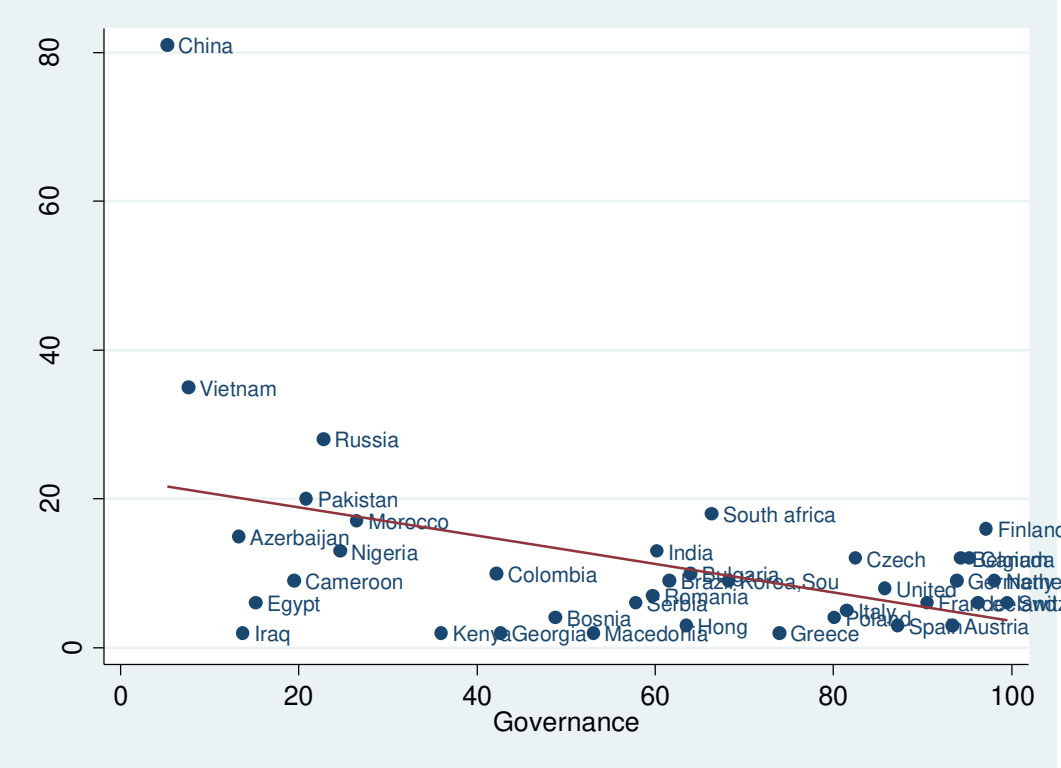

Figure 1

Relationship between views regarding security and governance (full sample)

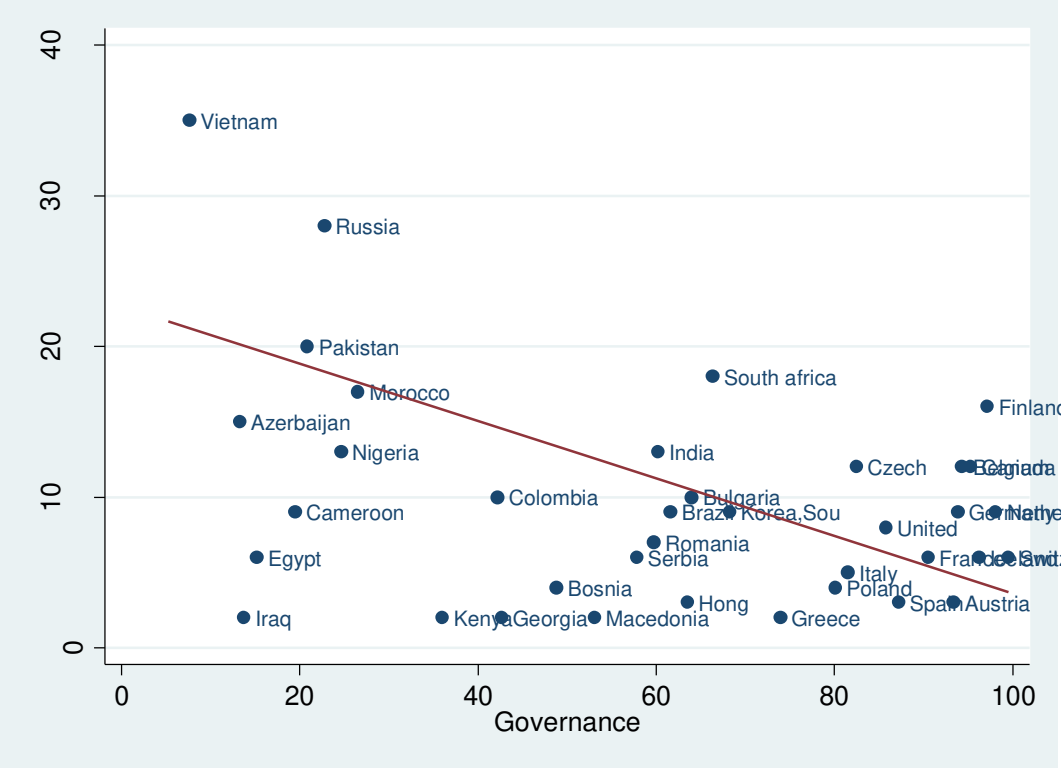

Figure 2

Relationship between views regarding security and governance (excluding China)

Table 1

Definition of variables and descriptive statistics

	Definition	With nuclear plants	Without nuclear plants.	t-statistics
SECR1	Rate of strongly agreeing that nuclear power plants in your country (or nearly country) are properly secured against accidents (%)	15.1	7.6	1.80*
SECR2	Rate of agreeing (or strongly agreeing) that nuclear power plants in your country (or nearly country) are properly secured against accidents (%)	44.0	22.7	4.35***
NUCLE	Country with nuclear energy takes 1, otherwise 0	---	---	---
GOVEN	Indicator for governance, 'Voice and Accountability' of the Worldwide Governance Indicators (World Bank)	71.2	46.8	2.29**
NDIS	Total number of natural disasters since 1970	152.7	49.3	1.85*
GDP	GDP per capita (million dollars)	2.3	1.5	1.85*
GOVSIZ	Government expenditure of GDP (%)	15.8	16.9	0.37
EASIA	Dummies for East Asian countries (China and Korea).	---	---	---

Note: Values in parentheses are absolute t-statistics. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. SECR1 and SECR2 are obtained from WIN-Gallup International (2011). GOVEN is obtained from http://info.worldbank.org/governance/wgi/index.asp (accessed April 28, 2011). NUCLE is collected from HP of European Nuclear Society (http://www.euronuclear.org/info/npp-ww.htm (accessed April 30, 2011). GDP and GOVSIZ are sourced from Penn World Table 6.3. http://pwt.econ.upenn.edu/php_site/pwt_index.php (accessed April 30, 2011). NDIS is obtained from the International Disaster Database http://www.emdat.be (accessed April 30, 2011).

Table 2(a)

OLS estimation; dependent variable: SECR1 (rate of strongly agreeing with the security of nuclear power)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
NUCLE	8.91***	11.3**	11.3**	8.77***	8.42***	8.48***
	(3.16)	(2.37)	(2.44)	(3.90)	(3.80)	(4.04)
GOVEN	–0.30*	–0.36*	–0.36*	–0.20**	–0.20**	–0.21**
	(–1.83)	(–1.86)	(–2.02)	(–2.29)	(–2.22)	(–2.43)
NDIS	0.02	0.02	0.02	–0.00001	0.004	0.0003
	(0.47)	(0.61)	(0.61)	(–0.01)	(0.03)	(0.03)
GDP	2.31	3.31	2.87	1.13	1.10	1.36
	(0.67)	(0.85)	(1.00)	(0.63)	(0.59)	(1.00)
GOVSIZ	0.05	0.04		–0.05	–0.04	
	(0.10)	(0.10)		(–0.21)	(–0.17)	
EASIA	19.5			–4.51**		
	(0.44)			(–2.20)		
Constant	16.1*	17.9*	18.7***	16.6**	16.3**	15.4***
	(1.75)	(1.95)	(2.80)	(2.58)	(2.51)	(3.79)
Adjusted R^2	0.55	0.47	0.48	0.28	0.29	0.31
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated using standard errors obtained using the jackknife method. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 2 (b)

OLS estimation; dependent variable: SECR2 (rate of agreeing (or strongly agreeing) with the security of nuclear power)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
NUCLE	27.1***	28.3***	28.5***	27.0***	26.1***	26.3***
	(5.84)	(5.17)	(5.37)	(6.41)	(6.24)	(6.47)
GOVEN	–0.48**	–0.51**	–0.54***	–0.40***	–0.39**	–0.42***
	(–2.44)	(–2.54)	(–2.91)	(–2.72)	(–2.61)	(–2.96)
NDIS	–0.0001	0.003	0.002	–0.01	–0.01	–0.01
	(–0.00)	(0.08)	(0.07)	(–1.03)	(–0.97)	(–0.96)
GDP	5.41	5.81	6.57**	4.31	4.26	5.43**
	(1.33)	(1.43)	(2.20)	(1.60)	(1.48)	(2.70)
GOVSIZ	–0.14	–0.14		–0.24	–0.22	
	(–0.22)	(–0.24)		(–0.57)	(–0.46)	
EASIA	9.78			–11.8***		
	(0.24)			(–3.33)		
Constant	39.8***	40.7***	38.0***	40.3***	39.5***	35.6***
	(3.28)	(3.44)	(5.27)	(4.01)	(3.79)	(5.58)
Adjusted R^2	0.52	0.52	0.53	0.45	0.45	0.45
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated using standard errors obtained using the jackknife method. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3(a)

2SLS estimation; dependent variable: SECR1 (rate of strongly agreeing with the security of nuclear power)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
NUCLE	10.0	10.7*	10.4*	11.3*	11.1*	11.4**
	(1.46)	(1.75)	(1.74)	(1.95)	(1.95)	(2.21)
GOVEN	–0.31**	–0.36**	–0.35**	–0.23**	–0.23**	–0.24**
	(–2.10)	(–2.10)	(–2.29)	(–2.18)	(–2.19)	(–2.50)
NDIS	0.01	0.02	0.02	–0.003	–0.002	–0.002
	(0.39)	(0.57)	(0.58)	(–0.20)	(–0.18)	(–0.20)
GDP	2.49	3.04	2.80	1.43	1.42	1.65
	(0.80)	(0.88)	(1.03)	(0.81)	(0.80)	(1.27)
GOVSIZ	0.05	0.04		–0.05	–0.04	
	(0.11)	(0.09)		(–0.23)	(–0.16)	
EASIA	18.7			–5.76*		
	(0.43)			(–1.88)		
Constant	16.3*	17.8*	18.6***	16.6**	16.5**	15.8***
	(1.79)	(1.90)	(2.80)	(2.58)	(2.65)	(3.86)
Over-identification (Sargan) Test	1.48 P-value=0.47	1.28 P-value=0.52	1.31 P-value=0.51	1.58 P-value=0.21	0.87 P-value=0.64	0.78 P-value=0.67
Adjusted R^2	0.62	0.54	0.54	0.27	0.37	0.36
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated using standard errors obtained using the jackknife method. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Instrumental variables are land area, population density, and log of population in 2009. These variables were obtained from the World Development Indicators 2010 (CD-Rom version).

Table 3(b)

2SLS estimation; dependent variable: SECR2 (rate of agreeing (or strongly agreeing) with the security of nuclear power)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
NUCLE	28.4***	28.5***	29.3***	29.3***	29.0***	30.3***
	(4.06)	(3.87)	(3.93)	(4.07)	(4.54)	(4.89)
GOVEN	–0.50***	–0.52***	–0.55***	–0.43***	–0.42***	–0.47***
	(–2.85)	(–2.82)	(–3.23)	(–3.31)	(–3.34)	(–3.77)
NDIS	–0.001	0.002	0.001	–0.02	–0.02	–0.02
	(–0.04)	(0.07)	(0.03)	(–1.04)	(–1.07)	(–1.15)
GDP	5.56	5.83	6.65**	4.61*	4.61*	5.84***
	(1.49)	(1.52)	(2.39)	(1.89)	(1.79)	(3.23)
GOVSIZ	–0.14	–0.14		–0.24	–0.21	
	(–0.23)	(–0.24)		(–0.89)	(–0.48)	
EASIA	9.14			–12.9***		
	(0.23)			(–3.13)		
Constant	40.0***	40.7*	38.1***	40.5***	39.7***	36.1***
	(3.34)	(3.42)	(5.30)	(4.21)	(3.97)	(5.83)
Over-identification (Sargan) Test	0.05 P-value=0.97	0.04 P-value=0.97	0.03 P-value=0.98	0.05 P-value=0.97	0.01 P-value=0.99	0.07 P-value=0.96
Adjusted R^2	0.60	0.59	0.58	0.54	0.52	0.50
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated by standard errors obtained by the jackknife method. *, ** and *** denote significance at the 10%, 5 % and 1% levels, respectively. Instrumental variables are land area, population density and log of population in 2009. These variables are obtained from World Development Indicators 2010 (CD-Rom version).

Table 4

First stage 2SLS estimations presented in *Table 3(1)* and *Table 3(2)*; dependent variable: NUCLE (country with nuclear energy takes 1, otherwise 0)

	Full sample			Excluding outlier (China)		
	(1)	(2)	(3)	(4)	(5)	(6)
Land area	0.43*	0.40*	0.40*	0.43*	0.43*	0.40*
	(1.87)	(1.69)	(1.75)	(1.82)	(1.70)	(1.76)
Population density	–0.005	–0.01	–0.01	–0.004	–0.005	–0.005
	(–0.07)	(–0.20)	(–0.20)	(–0.06)	(–0.08)	(–0.08)
Ln (population)	0.12**	0.13**	0.12**	0.12**	0.13**	0.13**
	(1.91)	(2.00)	(2.00)	(1.88)	(2.05)	(2.13)
GOVEN	0.01***	0.01**	0.01***	0.01***	0.01***	0.01***
	(2.86)	(2.54)	(2.75)	(2.78)	(2.75)	(2.96)
NDIS	–0.0004	–0.0001	–0.0001	–0.0004	–0.0005	–0.0004
	(–0.57)	(–0.27)	(–0.23)	(–0.58)	(–0.66)	(–0.66)
GDP	–0.07	–0.05	–0.06	–0.07	–0.07	–0.07
	(–0.68)	(–0.44)	(–0.61)	(–0.68)	(–0.61)	(–0.76)
GOVSIZ	0.001	0.001		0.001	0.001	
	(0.21)	(0.21)		(0.19)	(0.13)	
EASIA	0.48			0.44		
	(1.56)			(0.19)		
Constant	–1.48**	–1.53**	–1.46**	–1.58**	–1.58**	–1.54**
	(–2.05)	(–2.06)	(–2.24)	(–2.13)	(–2.13)	(–2.36)
Adjusted R^2	0.41	0.38	0.40	0.39	0.39	0.38
Observations	37	37	37	36	36	36

Note: Values in parentheses are t-statistics calculated using standard errors obtained using the jackknife method. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. Instrumental variables are land area, population density, and log of population in 2009. These variables were obtained from the World Development Indicators 2010 (CD-Rom version).

APPENDIX. List of countries used in the analysis

With nuclear plants	Without nuclear plants
Belgium	Austria
Brazil	Azerbaijan
Bulgaria	Bosnia and Herzegovina
Canada	Cameroon
China	Colombia
Czech	Egypt
Finland	Georgia
France	Greece
Germany	Hong Kong
India	Iceland
South Korea	Iraq
Netherlands	Italy
Pakistan	Kenya
Romania	Macedonia
Russia	Morocco
South Africa	Nigeria
Spain	Palestinian
Switzerland	Poland
United States	Serbia
	Vietnam

Note: Surveys were also conducted in Bangladesh, Fiji, Ireland, Japan, Latvia, Saudi Arabia, Tunisia, and Turkey. The question regarding the independent variable 'rate of thinking safety about nuclear energy' was not asked in these countries. Hence these countries are not used in the analysis. Information regarding nuclear countries was collected from HP of European nuclear society (http://www.euronuclear.org/info/npp-ww.htm (accessed April 30, 2011).